Civil Services (Main) Examination, 2010

CIVIL ENGINEERING
(Paper II)

Time Allowed : Three Hours **Maximum Marks : 300**

QUESTION PAPER SPECIFIC INSTRUCTIONS

(Please read each of the following instructions carefully before attempting questions)

There are EIGHT questions divided in two Sections.
Candidate has to attempt FIVE questions in all.
Question Nos. 1 and 5 are compulsory and out of the remaining, any THREE are to be attempted choosing at least ONE question from each Section.
The number of marks carried by a question/part is indicated against it.
Wherever any assumptions are made for answering a question, they must be clearly indicated.
Word limit in questions, wherever specified, should be adhered to.

SECTION 'A'

1. Answer any five of the following:

(a)(i) What is the purpose of dressing of stones? Mention the different types of surface finishes employed in stone masonry construction and illustrate by figures any two finishes. **6**

(a)(ii) What are the factors affecting the design and specifications of floor finish for residential rooms in a students' hostel. **6**

(b)(i) Mention the functions of each of bulldozer, scraper and hoe, and the site and job specifics for their use in the construction sector. **6**

(b)(ii) Mention the different bonds used in brick masonry and discuss in detail any two of them with figures. **6**

(c) The following table gives the data for the duration and cost for each activity in a CPM network. The indirect cost of the project is Rs. 90/day. Determine the optimum cost and the corresponding duration of the project. Note that only the indicated durations are permissible and no intermediate durations are permissible.

Activity	Normal Duration (days)	Normal Cost (Rs.)	Crash Duration (days)	Crash Cost (Rs.)
1-2	5	60	4	90
1-3	7	150	5	250
1-5	9	115	7	175
2-3	3	30	2	60
2-4	3	100	3	100
3-5	6	150	4	250
4-5	4	100	2	240

12

(d) A 4-lane National Highway is passing through a built-up area. Design the following geometric features for a horizontal circular curve of radius 350.0 m for this Highway. Consider design speed as 80 kmph and length of wheel base of largest truck as 6.0 m. (i) Superelevation (ii) Extra widening of pavement (iii) Length of Transition curve Also suggest the most suitable shape of curve. **12**

(e)(i) The following bearings were taken while running a compass traverse. At what stations do you suspect local attraction? Find the corrected bearings.

Line	Observed bearings
AB	N46°10′E
BA	S46°10′W
BC	S60°40′E
CB	N61°20′W

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CD	S10°30′E
DC	N8°50′W
DA	N79°40′W
AD	S80°40′E

(e)(ii) The following deflection angles were measured in running a traverse A-B-C-D-E-F-G

Station	Deflection Angle
A	
B	23°47′R
C	18°19′L
D	37°20′R
E	15°38′R
F	10°12′L
G	

If the true bearing of AB is N62°18′E, calculate the true bearings of the remaining sides. **6**

(f)(i) Define sleeper density. Calculate the number of sleepers required for constructing a B. G. Railway track of 10.0 km length, given the sleeper density as n+7. Length of each rail is 12.8 m. **6**

(f)(ii) Mention the relative merits and demerits of F. F. and B. H. rails. **6**

2. (a) A project of 12 months implementation duration has been planned and the cumulative cost build up in "units of money" as by (i) ESS and (ii) LSS have both been separately estimated as under – with the cost build up starting from "zero" at "zero" time and summating to 100 units of money at the end of the project duration – for both schedules. Values rounded to integers – Units of money

End of Month No.	0	1	2	3	4	5	6	7	8	9	10	11	12
Cum. cost by ESS	0	23	43	58	69	77	84	89	93	96	98	99	100
Cum. cost by LSS	0	4	8	13	18	24	30	37	45	54	66	82	100

Consider 1.2% p.m. compoundable monthly for the evaluation. What would be the excess interest involved on the project cost as on completion date if ESS were adopted in preference to LSS? Adopt "a month" as the unit time for this evaluation. **20**

(b)(i) Design and sketch the tie bars for a cement concrete pavement for a longitudinal joint using following data: Slab Thickness = 33 cm Lane width = 3.5 m Coefficient of friction = 1.5 Density of concrete = 2400 kg/m^3 Allowable tensile stress in plain bars = 1250 kg/cm^2 Allowable tensile stress in deformed bars = 2000 kg/cm^2 Allowable bond stress for plain bars = 17.5 kg/cm^2 Allowable bond stress for deformed bars = 24.6 kg/cm^2 **10**

(b)(ii) It is proposed to widen an existing 2-lane State Highway Section to a 4-lane divided road. Calculate the cumulative number of standard axles to be carried during the design life of (i) 15 years and (ii) 10 years in terms of msa taking the following data: Initial traffic in each direction = 5600 cv/day Design CBR of subgrade soil = 6.0% Traffic Growth rate = 8.0% V. D. F. = 4.5 Lane Distribution factor = 0.75 **10**

(c)(i) What are the objectives of building bye-laws? **5**

(c)(ii) Mention the factors affecting the selection of site for any general type of building. **5**

(c)(iii) Differentiate between the two items in each of (a) and (b): (a) Junction, Terminal Station (b) Gravity yard, Hump yard **10**

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3. **(a)(i)** Describe in detail the procedure for carrying out plastering in cement mortar on new and also old wall; discuss separately. **10**

(a)(ii) Briefly illustrate the details of (a) lean-to-roof, (b) coupled roof, and (c) collar roof. **5**

(a)(iii) What are the qualities of a good building stone? **5**

(b)(i) Enlist and sketch different types of pavement markings and explain their significance for safe traffic operation. **10**

(b)(ii) Speed observations from a radar speed meter are given below, giving data on speeds of subsidiary streams with the volume of traffic on each subsidiary stream. Calculate time-mean speed and space-mean speed.

Speed in km/hour	Volume of subsidiary stream in vehicle/hour
2-5	01
6-9	04
10-13	00
14-17	07
18-21	20
22-25	44
26-29	80
30-33	82
34-37	79
38-41	49
42-45	36
46-49	26
50-53	09
54-57	10
58-61	03

10

(c)(i)(a) How does the water cement ratio affect the strength of concrete? **5**

(c)(i)(b) Mention the causes of failures of reinforced concrete structures. **5**

(c)(ii) Two pegs *A* and *B* were 750 m apart across a wide river. The following readings were taken with the same levelling instrument:

Level Station	Readings on *A*	Readings on *B*
A	1.543	2.847
B	1.422	2.622

The error in the collimation adjustment of the level was + 0.002 m per 100 m. Determine the true difference of level between *A* and *B* and the extent of refraction correction. **10**

4. **(a)(i)** Discuss in detail the principles of site and office organisations in building industry. **10**

(a)(ii) Name the principal varieties of earth-moving machinery; and discuss the specific uses of any two of them. **10**

(b)(i) Calculate the load stresses at interior, edge, and corner regions of a cement concrete pavement using Westergaard's stress equations using the following data: Design wheel load = 5100 kg Modulus of Elasticity of concrete = 3.0×10^5 kg/cm^2 Pavement thickness = 180 mm Poisson's ratio = 0.15 Modulus of subgrade reaction = 6.0 kg/cm^3 Radius of contact area = 15 cm **10**

(b)(ii) Discuss the requirements of materials, plants and equipment and the adoptable construction steps for Built-up spray Grout. **10**

(c)(i) What is masonry work? Name different kinds of masonry and mention the principles to be observed in stone masonry exposed walls construction. **10**

(c)(ii) The scale of a photograph is 1.0 cm to 100 m. The photograph size is 23 cm × 23 cm. Determine the number of photographs required to cover an area of 15 km × 10 km, if longitudinal overlap is 60% and the side overlap is 30%, other conditions remaining **10**

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same.

SECTION 'B'

5. Answer any five out of the following:

(a) Explain if, and, if so, how, the Muskingham method can be realigned into the concept of stage slope method of flow computation in a river reach? If not, explain why not? **12**

(b) Explain the mutually interfering roles of post-jump height at a diversion headwork and normal depth of flow in the downstream channel. **12**

(c) A small town with a population of 1000 persons is to be supplied water at 96 lpcd. The demand of water during different periods is given as follows:

Time hr.	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24
Total Demand in litres	9000	10000	12000	18000	14000	12000	10000	11000

Determine the balancing capacity of a service reservoir if pumping is done in blocks of 24 hours, the delivery rate being constant. **12**

(d) Draw a neat sketch of a service pipe connection explaining the functioning and requirements of the various parts in the connection. **12**

(e) Determine the BOD loading of an oxidation pond used for treating the domestic sewage of 20,000 persons when the water supply demand is 100 litres per capita per day. Assume a detention period of 6 days and BOD of sewage as 300 mg/l. The pond is to be 1.2 m deep. **12**

(f) Stating a use-oriented definition of water pollution, list the various sources of water pollution along with the major characteristics of each of the stated source. **12**

6. (a) Consider the following three mutually exclusive options of providing a cut-off under a weir with aprons on a permeable bed: (i) one only on the upstream end of the apron (ii) one only under the toe of the weir (iii) one only at the extreme downstream end of the apron. Sketch (illustrating all resultant effects) the possible flow net diagram in each of the three cases – showing four of the flowlines nearest to the weir-cum-cutoff construction. **20**

(b)(i) Differentiate between super-chlorination and break-point chlorination. Explain break-point chlorination with a neat sketch explaining the types of chlorine form available in the various stages of the break-point curve. What is the significance of residual chlorine? **10**

(b)(ii) Describe the step-by-step procedure used for backwashing of a rapid sand filter. What is the significance of the backwash time and backwash velocity? **10**

(c)(i) What is Darcy's coefficient of permeability? How is it determined? Draw the necessary sketches. **10**

(c)(ii) Estimate the population equivalent for each of (a) combined system for 2000 prsons having 100 gm per capita daily BOD on the assumption that the contribution of BOD is 75 gm per capita per day. (b) 80,000 litres daily contribution of industrial wastes containing 1000 mg/litre of suspended solids on the assumption that the contribution of suspended solids is 50 gm per capita per day. State clearly any other assumptions needed to be invoked. **10**

7. (a) A part of a solid gravity dam (sp. gr. of mass concrete = 2.64) is shown in its cross-section. Take uplift factor as 0.7. Draw a tabular statement for analysis of forces at a horizontal section 26 m below water level. No ice, wind or seismic forces need to be considered. **20**

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[Figure: Cross-section of the upper part of a solid gravity dam. Top width 4 m; top of the dam 2 m above the water level (W.L.) on the upstream side. Upstream face vertical from the top down to 10 m below W.L., then battered at 1 in 10 down to the horizontal section considered, which is 26 m below W.L. Downstream face vertical for 6 m from the top, then sloping at 2 (horizontal) to 3 (vertical) down to the horizontal section. Dashed lines indicate that the dam continues below the section]

(b)(i) What will be the diameter of a circular sewer to carry a sewage discharge of 0.624 m^3/s when flowing full at a slope of 10 in 10,000. Use *n* as 0.012 in the Manning's formula. **10**

(b)(ii) In this sewer, what would be the discharge and velocity if the proportionate depth is held at 0.4? Use the table given herewith.

d/*D*	*q*/*Q*	*v*/*V*
0.4	0.32	0.88

10

(c)(i) Write a note on river training in the context of river pollution control at river banks through a typical Indian city. **10**

(c)(ii) Discuss the phenomenon of self-purification of streams. How can it be evaluated and represented? What are the factors that significantly affect the self-purifying abilities of a stream? **10**

8. (a) Consider a trapezoidal rigid boundary channel of 3 m base width with side slopes 1*h* to 1/2*v*, with depth of flow being 1.2 m, and *n*=0.012, with adequate free board. Sketch the shear stress distribution on the wetted perimeter. Explain the facts of zero and maximum, if both are so possible, shear stresses on each of the side slopes and on the bed – with reasons therefor. **20**

(b)(i) Enumerate and discuss the various factors that play a role in estimating the per capita demand of water supply. Also explain the implications if heavy metals are present in concentrations above their permissible levels. **10**

(b)(ii) Explain the meaning of "sustainable development" and its role in project planning. Also discuss the appropriateness of the "separate system of sewerage" in India. **10**

(c)(i) How would the radial flow in an open well be determined under steady state flow conditions when the aquifer is (a) unconfined, and (b) confined? **10**

(c)(ii) Write short notes on each of: (1) Reflux Valve (2) Air-Relief Valve (3) Expansion joint in a water supply distribution system. **10**

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